

UNIVERSITY OF CALIFORNIA  
COLLEGE OF AGRICULTURE  
AGRICULTURAL EXPERIMENT STATION  
BERKELEY, CALIFORNIA

# FEEDING AND MANAGEMENT OF DAIRY CALVES IN CALIFORNIA

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BULLETIN 478

OCTOBER, 1929

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UNIVERSITY OF CALIFORNIA PRINTING OFFICE  
BERKELEY, CALIFORNIA,

1929



# FEEDING AND MANAGEMENT OF DAIRY CALVES IN CALIFORNIA

S. W. MEAD<sup>1</sup>

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## INTRODUCTION

It is becoming increasingly difficult to maintain and improve a dairy herd through the addition of females by purchase. Successful herd management requires the raising of young stock. Not only is it difficult to produce butterfat at a profit with a diseased herd, especially one infected with either tuberculosis or contagious abortion, but legal restrictions designed to safeguard public health are making it more difficult to sell either milk or cattle from herds affected with these diseases. As a result, the prices of healthy cattle have been stimulated to a figure beyond their value for milk production. For the average dairyman, therefore, herd improvement must come through a well-planned breeding program, which necessitates the raising of all normal healthy female calves from the best cows in the herd, sired by a carefully selected purebred bull. This bulletin has been prepared in answer to numerous requests from California dairymen for information concerning methods of feeding and management of heifers from birth to first calving.

## GENERAL PRINCIPLES OF NUTRITION

There are very few hard and fast rules for the feeding of livestock. It is only through a knowledge of the fundamental principles of nutrition that the special needs of the individual animal may be supplied.

The animal body is composed of at least six general classes of food substances: proteins, carbohydrates, fats, minerals, water, and vitamins. In the process of growth the body requires a constant supply of these food materials. When the proper amounts are furnished in the right proportions, the animal is said to be receiving a balanced ration. All of these nutrients are found in the natural foods in varying proportions. No one food stuff contains all the materials necessary for a balanced ration. Milk is a complete food during early life but later fails to satisfy all the requirements for normal growth and development.

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*Proteins.*—Proteins contain nitrogen and are used to build new tissue and to aid in the natural functioning of certain organs. Proteins can also be used as a source of energy. They are important constituents of milk. Such concentrates as linseed-oil meal and cottonseed meal, and such leguminous roughages as alfalfa or clover hay, are rich in protein.

*Carbohydrates and Fats.*—The principal function of carbohydrates is to supply energy needed to carry on the life processes, to warm the body, and to build adipose or reserve tissue. All of the cereals and cereal hays contain relatively large amounts of carbohydrates. Fats, which are also used as a source of energy, are  $2\frac{1}{4}$  times as valuable for this purpose as an equivalent amount of carbohydrates.

*Minerals.*—Minerals are necessary for regulating the body processes and for developing the skeleton. An adequate supply is extremely important, especially for the rapidly growing animal and the high-producing cow. The importance of common salt is definitely known. It may be fed by adding one pound of salt to each 100 pounds of the concentrate mixture or by allowing the animals free access to it. Our present knowledge of other minerals and their role in animal nutrition is limited. The fact that rations are frequently deficient in calcium and phosphorus indicates the probability that these are the two elements of most importance to the livestock feeder. Though the grains as a class are high in phosphorus, and the legumes, such as alfalfa, vetch, and clover, high in calcium, to assure an ample supply a mineral supplement should be added to the concentrate mixture fed to growing stock. Two per cent of steamed bone meal or spent bone black is sufficient for this purpose.

*Water.*—The animal body is composed of about 60 per cent water. A plentiful supply of clean, fresh water is therefore important, even for calves that are being fed milk.

*Vitamins.*—In formulating concentrate mixtures and in selecting roughages for feeding livestock, one must keep in mind the need of the animal for the materials mentioned above. A proper balance, as well as a sufficient amount, is important. Such a ration, however does not necessarily satisfy all of the requirements for normal growth and development unless it contains vitamins. Although very little is known concerning the identity or chemical composition of vitamins, the effect of their presence or absence in the ration can very readily be demonstrated. Five, known as vitamins A, B, C, D, and E, have been accepted, and investigations now under way indicate that there may

be others. Not all of these have been proved necessary to the well being of dairy cattle. While it has been shown that vitamin A, which promotes growth, is indispensable in the diet of calves,<sup>(1)</sup><sup>2</sup> there is little reason to believe that B<sup>(2)</sup> or C<sup>(3)</sup> is needed. Whole milk satisfies the vitamin A requirements of the young calf, and alfalfa those of the older animal. The importance of vitamin D to the health of the calf has not been determined, but since green plant tissue is rich in this vitamin, there is little danger of a shortage under common methods of management. It has been established that vitamin E,<sup>(4)</sup> which is abundant in most green plants, is essential to the normal functioning of the reproductive mechanism of certain animals, especially the rat, and while experimental evidence is lacking in this connection for the bovine, it is not unreasonable to believe that E is necessary for normal reproduction in cattle. Hence, some green feed should be supplied during at least a part of the year.

#### COMMON FEEDS

*Milk.*—Whole milk is very palatable and easily digested. From the nutritive standpoint, its solids are especially adapted to the needs of the young animal. It supplies not only proteins of good quality, but the vitamins that are necessary for satisfactory growth and development, and also, under normal conditions, most of the minerals known to be important in nutrition. Except for butterfat and its associated substances, skim milk is similar in food value to whole milk. Properly processed dry skim milk differs further only in the absence of water.

*Concentrates.*—The *cereal grains* such as barley, oats, corn, milo, and Egyptian corn are quite similar in their nutritive value. They are all deficient in lime and proteins, the latter being incomplete and hence of inferior quality. These grains however, are suited to feeding with skim-milk because the milk proteins adequately supplement those of the grains, and the grains in turn furnish the energy to replace the butterfat.

*Wheat bran and rice bran*, though poor in calcium, are rich in both phosphorus and protein and because of their fluffy nature add lightness to the concentrate mixture. Rice bran has the disadvantage that under certain conditions it becomes unpalatable because of the development of rancidity.

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<sup>2</sup> Superscript numbers in parentheses refer to "Literature Cited," at the end of the bulletin.



Although similar to bran in its calcium and phosphorus content, *coconut meal* is somewhat higher in protein. Because it is rich in an unstable fat, age and high temperatures often cause it to become rancid and unpalatable.

*Linseed and soybean meals* are high in phosphorus and protein, low in calcium, and extremely palatable.

*Roughages.*—Alfalfa, clover, vetch, and other *legume hays*, when properly cured, are among the best roughages for livestock feeding. They furnish proteins of good quality and are extremely rich in lime and the necessary vitamins. Their palatability is excellent.

In sections where alfalfa or other legumes cannot be profitably grown, the feeder must depend upon such *cereal and grass hays* as oat, barley, wheat, or Sudan grass. These are all similar in their nutritive characteristics, being low in both minerals and protein and of only fair palatability. For satisfactory results, they must be supplemented with protein and minerals.

While *silage* is extremely satisfactory for the feeding of older animals, it is not a desirable feed for very young calves, because of its bulky nature and varying acidity.

#### KIND OF CALF TO RAISE

The dairyman should save only those calves that can be raised most economically. Calves from high-producing cows, sired by a carefully selected purebred bull, cost less to raise because of the low percentage of culls. Calves that are small, weak, or unhealthy at birth are difficult to raise, require more attention and a longer growing period, have a higher mortality, and as a result cost more to raise.

The question often arises as to the value of a cow's first calf. Aside from the fact that it is usually small, it has an equal chance with any of her later calves of developing into a good cow.

A female, twin to a male, is usually sterile and is known as a free-martin. All other twin calves may be raised with the assurance that twinning has not impaired their breeding powers.

Bull calves should be disposed of at birth unless the breeding is of the best and there is a ready sale or a need in the herd for such animals. Only under very unusual conditions is it profitable to attempt to produce veal from dairy bull calves.

### CARE DURING EARLY LIFE

The normal healthy calf comes into the world with a strong stimulation to grow. Certain factors, most important of which is disease, are continually operating to discourage its normal development. Where sanitary conditions are not good much trouble may be avoided by proper disinfection of the umbilical or navel cord, which at birth is a ready channel of infection. The cord should first be emptied by grasping it between the thumb and forefinger at a point near the body and pressing downward to the end, after which the cord and a small area surrounding it should be painted with tincture of iodine or other suitable disinfectant.

Unless the mother gives it proper attention, the calf should be dried with a clean cloth or straw. Drafts should be avoided, and both the calf and mother should be kept comfortable.

The normal calf will usually stand alone and attempt to nurse within an hour after birth. It is extremely important for the calf to receive a generous feeding of colostrum, the mother's first milk. This contains substances that aid the calf in resisting disease during its early life, has a beneficial laxative action, and is assumed to be especially suited for nourishing the new-born calf.

Usually after 36 to 48 hours, the calf will have received sufficient colostrum and may be removed from the dam. At this early age little difficulty will be encountered in teaching it to drink. This is most easily accomplished by allowing the calf to suck one's fingers in a pail of milk while gradually drawing them away. After a few trials the calf will drink readily. In stubborn cases it may be necessary to withhold feeding for 24 hours until the calf becomes very hungry.

*Marking for Identification.*—Before it is removed from the dam, the calf should be given some mark of identification. For this purpose a tag bearing the herd number is sometimes fastened about the neck by means of a strap. After first calving, this tag is removed and a smaller one inserted in the right ear. Tattooing is another means of identification commonly used, the left ear being marked with the herd number. It is a good plan to examine the ear at one year of age, and if the number has faded out through growth, the right should then be tattooed. The necessary equipment for tattooing may be obtained from commercial supply houses. The ear should be wiped clean, and all waxy secretions on the inside surface should be removed with a cloth moistened with gasoline or other fat solvent. The fat



*Remove the oily secretions.*



*Smear the ear and points of the stamp with tattoo ink.*



*Imprinting the tattoo.*



*Rubbing the tattoo ink into the punctures.*



*The tattoo is a satisfactory permanent method of identification.*

Fig. 1.—Tattooing the ear. Successful dairy herd management requires that each animal be given a permanent mark of identification.

solvent itself must then be carefully wiped off. This part of the procedure is extremely important, for the tattoo ink will not 'take' if any wax or oil is present. A generous amount of the tattoo ink, black for light ears and red for black ears, is then applied to the ear and to the numbers or letters to be used. The ear should be held between the thumb and fingers while it is punctured with the tattoo. Tearing may be avoided by pushing the ear away from the points of the instrument as the pressure is being released. The ink must be immediately rubbed into the punctures. The illustrations in figure 1 will be of assistance to the beginner.

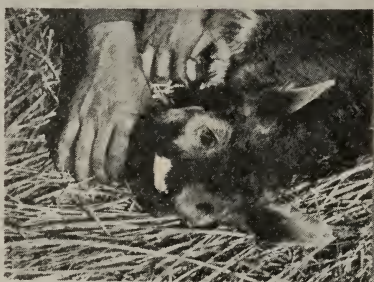




*Clip hair from rudimentary horn and surround with grease ring.*



*Apply caustic.*



*Horn cells completely destroyed by the treatment.*



*Proper dehorning gives a natural polled appearance.*



*The result of a shiftless job.*

Fig. 2.—Dehorning with caustic. When properly used, caustic is satisfactory in preventing the growth of horns.

**Dehorning.**—The practice of preventing the growth of horns on heifer calves by the use of caustic potash, procurable at any drug store, is becoming common. It is a good plan to allow the horns to grow on bull calves, for their removal at a later age may serve to curb an unruly temperament.

The treatment should be applied before three days of age. The hair must be clipped from an area about one inch in diameter over the rudimentary horns, which can be felt beneath the skin. A small

amount of heavy grease should be spread around the outer edge of this area to prevent the caustic from running into the eyes and causing permanent blindness. Paper should be wrapped around the stick of caustic to prevent burning the hands. The calf is then placed on its side with the head held firmly against the ground. The surface lying immediately over the horn is rubbed with the end of the caustic stick until the hair is removed, care being taken not to cause bleeding. After the process has been repeated on the other horn, the calf should be placed in a pen alone for at least a day. It must not be turned out during rainy weather, for the rain will wash the caustic into the eyes in spite of the grease ring. If the work is done properly, no horns will develop. Careless treatment, however, will result in the growth of scurs or crooked horns which will spoil the appearance of the animal's head. The various steps in the procedure are shown in figure 2, with illustrations of properly and improperly dehorned calves.

If the horns are not prevented from growing by the use of caustic, they may be removed with horn clippers or saw. In which case, one should allow the animal to reach an age of 18 months in order to avoid a possible recurrence of horn growth. The dehorning should be done during the winter months to avoid the danger of contamination by flies; but the animals should be kept under cover in rainy weather until the opening in the head is closed.

*Feeding.*—Regardless of the feeding method to be used, the average calf should receive whole milk during the first two weeks of its life. Small or weak calves require milk for a longer period, while exceptionally large and strong ones may need very little after the first ten days. The amount to feed daily also varies with the size and vitality. A large, strong, healthy calf may do well on twice as much milk as will one underweight at birth. The stomach of the young calf is incapable of handling large quantities of food. Over-feeding, a mistake often made in an effort to induce the animal to grow rapidly, results in indigestion, which is indicated by scouring, a condition that seriously retards growth. Milk should not be fed to the limit of the calf's appetite. Sudden changes in either quantity or quality are disastrous. The milk for each calf must be measured accurately. A spring scale, fitted with a hook on which a pail may be hung, will be found satisfactory for this purpose.

During the first few days the calf should receive a relatively small amount of milk, which is gradually increased daily. As a general rule, Jerseys and Guernseys should receive an average of 5 or 6 pounds of

milk daily for the first two weeks; Holsteins and Ayrshires 7 or 8 pounds. A common rule is to feed 10 or 12 pounds daily for each 100 pounds of live weight.

During the first two or three weeks the daily ration of milk should be given in three feedings, after which two will usually suffice. If whole milk is to be continued, the amount should be increased daily. It is unnecessary at any time to feed more than 16 or 18 pounds of either the whole or skim milk. After ten days of age, concentrates and roughage should be available at all times.

The milk should always be sweet and clean and for the first two months should be fed at body temperature, 100° Fahrenheit. A thermometer should be used to determine this temperature. For older calves the milk need not be quite so warm nor so uniformly the same temperature at each feeding. It should, however, never be fed cold. Milk too rich in fat is often the cause of indigestion and scours. As a rule, milk with a butterfat content of about 3.5 per cent will give most satisfactory results.

Individual pens may well be provided during the first two or three weeks; later, calves of much the same age may be placed together in a community pen provided with stanchions in which they may be fastened during milk feeding, assuring each its proper amount of milk. More than one such pen permits dividing the calves into groups of similar age.

#### METHODS OF FEEDING AND MANAGEMENT FROM TWO WEEKS TO SIX MONTHS OF AGE

*Whole Milk.*—Whole milk, properly supplemented with concentrates and roughage, cannot be surpassed for producing maximum growth. Under most conditions however it is too expensive to use beyond the first 4 weeks of age except for animals intended for immediate sale or show.

*Skim Milk.*—It is a generally accepted fact that as far as the future development and usefulness of the animal is concerned, skim milk after the first two weeks gives as good results as whole milk and when available is less expensive than any other satisfactory food for calves. Animals thus fed are not, however, so fat and sleek at 6 months of age as those fed whole milk. As shown in table 1 the only appreciable difference between whole and skim milk is in the butterfat content. For this reason, the concentrate ration may consist of any of



the cereals. The addition of oil meal and bran, however, will improve the palatability and thereby induce the calves to consume larger quantities and thus to make more rapid growth.

For the first two weeks the calf should receive whole-milk. After this period, however, the whole milk should be gradually reduced and replaced by an equal amount of skim milk. A week usually suffices for making the substitution. After the change is made, the amount may be increased gradually to 18 pounds daily, this being the maximum that is usually fed to even the largest calves.

In order to obtain information applicable to California conditions, feed and growth data were collected on 21 dairy heifers raised by the skim-milk method. The calves, of which 10 were Holsteins and 11

TABLE 1  
COMPOSITION OF WHOLE MILK AND SKIM-MILK

Feeds	Water	Fat	Protein	Sugar	Ash
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
Whole milk.....	87.10	3.90	3.40	4.75	0.75
Skim milk.....	90.50	0.10	3.57	4.95	0.78

Jerseys, were dropped in the University herd. They were kept with the dam for the first 24 to 48 hours, after which they were removed to separate pens. On the average, they received whole milk to 15 days of age, at which time a gradual change was made to skim milk. At the end of 22 days, the change had been completed. The following concentrate mixture in addition to alfalfa hay was available after the first 10 days:

200 pounds of rolled barley  
150 pounds of rolled oats  
150 pounds of wheat bran  
50 pounds of linseed oil meal  
4 pounds of spent bone black  
3 pounds of salt

The calves were allowed all the alfalfa hay they would eat, but were limited to 5 pounds daily of the concentrate mixture. Accurate records were kept of all feed consumed by each individual. Since body weight alone is not an accurate measure of growth, height at withers as well as body weight was recorded monthly.

Having shown that an animal kept on a maintenance ration which permitted no increase in weight would continue in skeletal growth, and that the height at withers was an accurate measure of this increase, Eckles,<sup>(5)</sup> by weighing and measuring a large number of dairy



heifers of various ages, established the average growth figures for Ayrshires, Jerseys, and Holsteins given in table 2. These normals are used as a standard for measuring the effect on growth of the various methods of calf raising reported in this bulletin.

TABLE 2  
NORMAL BODY WEIGHT AND HEIGHT AT WITHERS OF FEMALES DURING THE GROWING PERIOD

Age in months	Holsteins		Jerseys		Ayrshires	
	Height	Weight	Height	Weight	Height	Weight
	<i>inches</i>	<i>pounds</i>	<i>inches</i>	<i>pounds</i>	<i>inches</i>	<i>pounds</i>
Birth	28.3	90	26.0	55	.....	69
1	30.2	121	27.7	76	27.5	90
2	32.3	157	29.4	105	29.5	128
3	34.2	200	31.2	140	31.2	170
4	36.2	249	32.9	174	33.1	218
5	38.0	302	35.1	222	35.1	254
6	39.7	349	36.9	260	36.4	286
7	40.9	389	38.1	302	37.3	304
8	42.2	425	39.3	340	38.5	336
9	42.9	466	40.5	376	39.0	366
10	43.8	501	41.3	407	39.6	406
11	44.3	529	41.9	432	40.1	427
12	44.8	558	42.6	456	40.7	456
13	45.6	574	43.3	480	41.3	485
14	46.2	596	43.8	503	42.0	533
15	46.8	612	44.4	520	42.4	547
16	47.4	643	44.6	533	42.7	560
17	47.7	660	45.1	553	43.1	579
18	47.9	686	45.5	572	43.7	604
19	48.3	715	46.0	598	44.2	627
20	48.7	746	46.3	621	44.6	651
21	48.9	774	46.5	649	44.9	679
22	49.2	796	46.8	668	45.4	707
23	49.5	824	47.2	689	45.6	733
24	49.8	841	47.4	716	45.9	759
25	50.2	869	.....	737	46.6	798
26	50.5	893	.....	758	46.7	807
27	50.9	925	48.0	770	46.8	859
28	51.1	956	.....	784	46.9	.....
29	51.3	994	.....	804	47.0	.....
30	51.5	1021	48.3	.....	47.2	.....

Table 3, which gives the average results of the skim-milk trial to six months of age, may be used as a guide for raising calves if consideration is given to the fact that individual calves require different amounts of feed and that some calves may need whole milk to a somewhat greater age than is indicated in the table, while others may be changed to skim milk earlier. The average growth data are presented graphically in figure 3. In California trials, considerable individual variation was noted among the calves. As shown in table 3, there was

TABLE 3  
DAILY FEED CONSUMPTION AND GROWTH OF DAIRY HEIFERS RAISED BY  
THE SKIM-MILK METHOD

Age in days	Pounds feed consumed				Age in days	Body weight		Height at withers	
	Whole milk	Skim milk	Concen- trates	Alfalfa hay		Pounds	Per cent normal	Inches	Per cent normal
Average of ten Holsteins									
Birth.....					Birth	81.8	90.8		
1.....	With dam								
2.....	36 hours								
3-10.....	8.0								
11-15.....	8.0		0.25	Free access					
16.....	7.0	1.0	0.25						
17.....	6.0	2.0	0.25						
18.....	5.0	3.0	0.25						
19.....	4.0	4.0	0.25						
20.....	3.0	5.0	0.25						
21.....	2.0	6.0	0.25						
22.....	1.0	7.0	0.25						
23-30.....		7.5	0.70		30	97.0	80.1	29.0	96.0
31-60.....		13.0	1.50		0.3	60	140.4	89.4	31.2
61-90.....		16.0	2.50	0.5	90	185.5	92.7	33.6	98.2
91-120.....		15.0	3.50	1.5	120	245.6	98.6	35.7	98.6
121-150.....		13.0	4.50	2.5	150	303.2	100.4	37.7	99.2
151-180.....		9.0	5.00	3.5	180	362.1	103.7	39.4	99.2
Average of eleven Jerseys									
Birth.....					Birth	51.6	93.8		
1.....	With dam								
2.....	48 hours								
3-10.....	6.0								
11-15.....	6.0		0.20	Free access					
16.....	5.5	0.5	0.20						
17.....	5.0	1.0	0.20						
18.....	4.0	2.0	0.20						
19.....	3.0	3.0	0.20						
20.....	2.0	4.0	0.20						
21.....	1.0	5.0	0.20						
22.....	1.0	5.0	0.20						
23-30.....		6.5	0.50		30	63.2	83.1	26.0	93.8
31-60.....		10.0	0.80		0.3	60	89.3	85.0	27.8
61-90.....		13.0	1.50	0.4	90	123.3	88.0	29.9	95.8
91-120.....		15.0	2.00	0.8	120	159.8	91.8	32.1	97.5
121-150.....		14.5	3.50	1.4	150	206.3	92.9	33.7	96.0
151-180.....		12.0	4.50	1.7	180	251.1	96.5	35.4	95.9

a reduction in the amount of skim milk consumed by the Holsteins after the third month, and by the Jerseys after the fourth. This was due to the fact that certain of the calves in each group refused the milk at this age, probably because they were consuming a considerable amount of the concentrate mixture.

The individual feed and growth data are presented in table 4. These records should impress the feeder with the importance of looking upon each calf as a separate problem requiring individual care. As a rule,

TABLE 4  
INDIVIDUAL FEED AND GROWTH RECORDS OF DAIRY HEIFERS RAISED BY THE SKIM-MILK METHOD, FROM BIRTH TO SIX MONTHS OF AGE

Herd No.	Total feed consumed				Growth measurements							Digestible nutrients consumed	
					At birth		At 6 months		Height at 6 months	Per cent normal	Total	Per pound gain in weight	
	Whole milk	Skim milk	Concen- trates	Alfalfa hay	Body weight	Per cent normal	Body weight	Increase					Per cent normal
Holsteins													
147	pounds 157.4	pounds 2,271.2	pounds 566.5	pounds 192.0	pounds 85.0	per cent 94.4	pounds 365.9	pounds 280.9	per cent 104.8	inches 40.6	per cent 102.3	pounds 751.9	pounds 2.7
148	103.8	2,305.9	524.3	277.9	85.0	94.4	380.0	295.0	108.9	38.8	97.7	741.2	2.5
149	133.3	2,223.6	557.7	134.3	72.0	80.0	345.0	273.0	98.9	39.0	98.2	688.1	2.5
150	148.4	2,298.8	524.1	149.5	78.0	86.7	356.2	278.2	102.1	38.6	97.2	681.4	2.4
152	140.0	1,912.2	629.4	270.5	92.0	102.2	442.2	350.2	126.7	41.2	103.8	781.9	2.2
153	151.6	2,351.9	511.4	252.3	86.0	95.6	340.0	254.0	97.4	39.8	100.3	731.6	2.9
154	153.3	2,254.2	514.5	231.3	85.0	94.4	362.0	277.2	103.7	40.2	101.3	713.5	2.6
155	166.6	2,097.6	315.3	172.8	75.0	83.3	290.0	215.0	83.1	37.6	94.7	530.3	2.5
157	192.3	1,457.3	511.1	384.4	80.0	88.9	376.2	296.2	107.8	39.7	100.0	709.4	2.4
158	93.4	1,301.3	528.5	405.7	80.0	88.9	363.4	283.4	104.1	38.4	96.7	717.1	2.5
Jerseys													
420	124.4	1,772.6	431.2	104.0	55.0	100.0	263.0	208.0	101.2	35.9	97.3	575.7	2.8
421	88.9	1,892.5	224.8	96.6	55.0	100.0	224.6	169.6	86.4	34.2	92.7	387.1	2.3
423	93.0	2,106.1	411.7	158.7	48.0	87.3	251.2	203.2	96.6	35.4	95.9	578.7	2.8
428	99.1	2,396.5	396.2	154.3	55.0	100.0	270.0	215.0	103.8	36.4	98.6	594.3	2.8
429	69.9	2,054.7	235.1	39.1	33.0	60.0	183.6	150.6	70.6	31.9	86.4	384.9	2.6
431	108.2	2,312.9	470.9	170.5	60.0	109.1	286.6	226.6	110.2	36.4	98.6	649.4	2.9
433	89.0	2,336.5	438.4	196.9	53.0	96.4	272.3	219.3	104.7	36.8	99.7	639.0	2.9
442	105.0	1,997.9	356.0	135.5	67.0	121.8	254.0	187.0	97.7	36.6	99.2	520.8	2.8
444	103.9	1,793.5	269.5	125.4	49.0	89.1	241.4	192.4	92.8	35.9	97.3	439.5	2.3
445	110.9	1,442.4	528.5	211.9	53.0	96.4	306.1	253.1	117.7	36.2	98.1	633.2	2.5
447	127.5	2,106.0	286.8	130.4	39.0	70.9	209.7	170.7	80.7	33.9	91.9	482.6	2.8

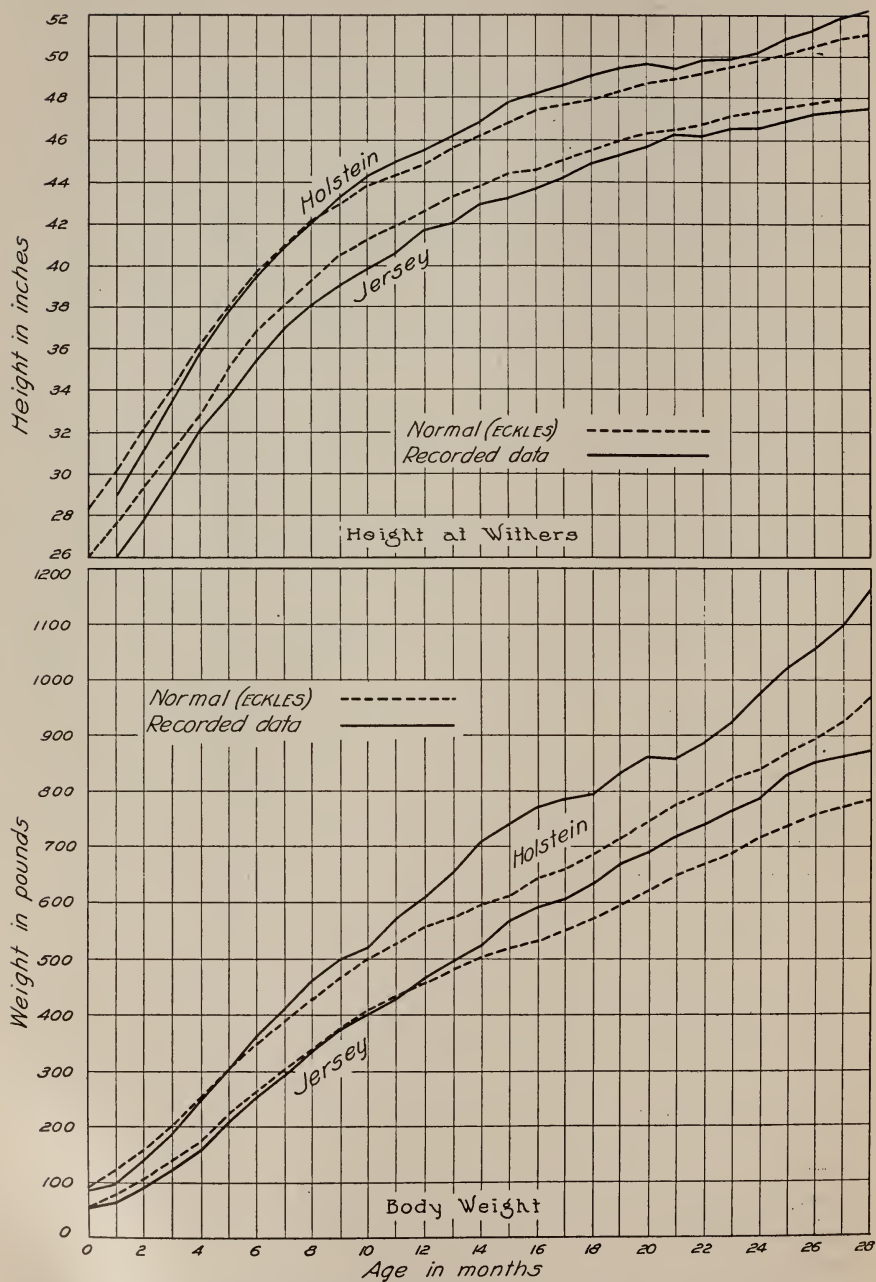


Fig. 3.—Growth of calves raised by the skim-milk method, compared to the normal.



the greatest gains are made by those calves that consume the greatest amounts of feed. For example, the greatest increase in weight from birth to six months of age in the Holstein group was made by calf No. 152. This heifer consumed the greatest amount of total digestible nutrients, while No. 155, which made the poorest gains, consumed the least. It is to be noted also that while No. 155 weighed practically the same at birth as No. 149, at which time both were much below the normal for the breed, the former was only 83.1 per cent normal in weight at six months of age, while the latter was 98.9 per cent normal. The difference results from the fact that No. 149 consumed 157.8 pounds more total digestible nutrients than No. 155. It is evident, then, that while heifers can be raised on less feed than is shown in table 3, which represents the average for all animals, a more liberal ration, within certain limits, will induce greater gains and result in earlier maturity. This question will be discussed more in detail under "Care from One Year of Age to First Calving."

*Minimum Skim Milk.*—Normal healthy calves may be weaned from skim milk at 90 days of age. They should be raised according to the skim-milk method until this time. The milk is then discontinued, and a dry concentrate and roughage ration substituted. From the very earliest age the calves must have access to concentrates and roughage, in order that the digestive tract may become adjusted to handling the coarser feeds. There should be a considerable increase in the consumption of concentrates and hay when the change is made.

Where only a limited amount of skim milk is available, this method will give very satisfactory results. Up to six months of age the growth will not be so rapid, especially if the calves are under weight at birth. After this period, however, the rate of growth increases, and by the time the heifers are one year of age, they will be normal in size for the breed.

Eight purebred Jersey heifer calves were raised by this method for the purpose of comparing their feed consumption and rate of growth with those of calves receiving skim milk to six months of age. In table 5 are presented data showing the average amounts of feed consumed monthly and the growth compared to the normal. These calves received the same concentrate mixture as those fed skim milk to six months of age. The roughage used was alfalfa hay. In table 6 are shown the individual records of growth compared to the normal, and in table 7 the feed records compared with the growth measurements at birth and at six months. Figure 4 is a graphical representation, from birth to 12 months of age, of the average body weight and height at withers compared to the normal.

Some difficulty was experienced with scours during the whole milk-feeding period. The consumption of concentrates was therefore low and the daily gains less than should be expected of calves that were normal at birth. From table 5 it will be seen that these animals

TABLE 5

RECORD OF AVERAGE FEED CONSUMED AND GROWTH, BY MONTHS, FOR CALVES  
RAISED BY THE MINIMUM SKIM-MILK METHOD

Age in months	Pounds feed consumed				Body weight		Height at withers	
	Whole milk	Skim milk	Concentrates	Alfalfa hay	Pounds	Per cent normal	Inches	Per cent normal
Birth	With dam 48 hours				50.1	91.1		
1	109.2	56.1	3.1	1.4	59.2	77.9	25.7	92.8
2		294.0	17.9	9.0	84.3	80.3	27.3	92.9
3		353.4	38.5	24.6	119.5	85.4	29.5	94.6
4			86.0	54.0	147.5	84.8	31.2	94.8
5			102.8	64.5	183.2	82.5	33.1	94.3
6			127.1	73.9	223.1	85.8	34.9	94.6

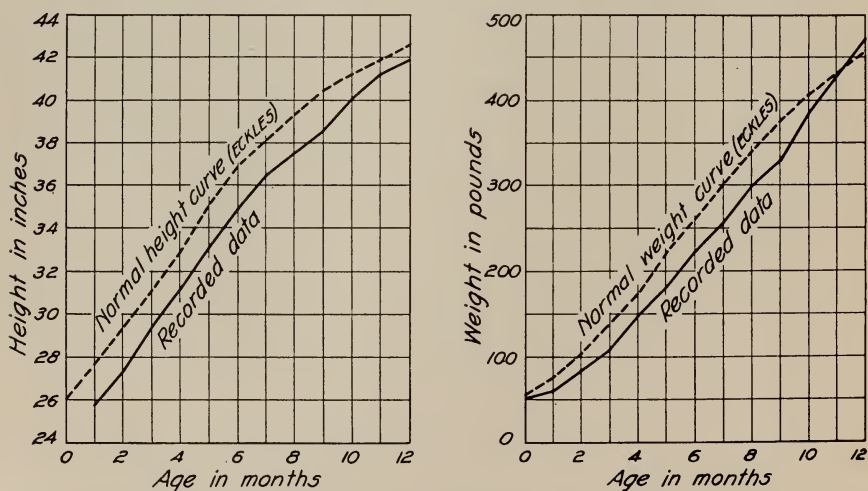


Fig. 4.—Growth of calves raised by the minimum-skim-milk method, compared to the normal.

were on the average only 85.8 per cent normal in weight but 94.6 per cent normal in height at six months of age. Table 6, however, shows that each approached the normal for the breed very rapidly after 6 months of age, and before 12 months, all but one were practically normal. Because no pasture was available, they received during the period from six to twelve months of age, 12 pounds of silage, 4 pounds of alfalfa hay, and 2 pounds of a concentrate mixture daily;

TABLE 6  
INDIVIDUAL GROWTH RECORDS IN PERCENTAGE OF THE NORMAL FOR JERSEY CALVES RAISED BY THE MINIMUM-SKIM-MILK METHOD

Calf No.	453		455		456		458		462		464		466		468	
Age	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height
mos.	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Birth	109.1	92.4	85.5	93.9	103.6	83.3	94.9	87.9	98.2	92.4	65.4	80.0	88.1	69.7	96.4	74.5
1	85.5	92.4	66.7	93.9	83.3	91.0	95.6	83.8	87.9	93.9	64.9	83.8	89.1	70.5	92.5	71.1
2	99.0	98.0	65.9	89.8	91.0	95.6	94.5	84.1	94.6	94.9	75.1	93.1	86.9	97.4	92.9	77.9
3	114.3	99.7	62.4	90.4	85.0	94.6	94.6	84.1	94.6	94.9	75.1	93.1	86.9	97.4	92.4	93.6
4	110.3	97.6	58.9	89.4	82.5	94.5	94.5	83.4	96.7	96.7	78.6	91.2	85.9	97.9	93.4	82.5
5	103.6	100.0	55.0	88.0	81.9	94.5	94.5	81.3	96.3	96.3	76.6	90.3	84.0	94.9	94.0	83.8
6	105.4	100.8	58.5	87.8	84.9	95.7	95.7	85.3	96.7	96.7	76.7	89.7	90.6	94.9	97.3	95.1
7	105.6	101.3	59.6	87.9	84.9	96.1	96.1	86.5	97.9	97.9	75.8	92.4	93.0	99.2		87.7
8	106.9	96.2	67.4	90.3	88.5	95.7	95.7	87.5	98.5	98.5	81.8	94.7	99.7			
9	106.0	98.8	70.7	90.4	88.4	93.8	93.8	91.9	97.8	97.8	89.1	94.1				
10	115.5	99.8	71.7	93.0	93.3	98.3	98.3	96.3	99.0	99.0	94.6	96.4				
11	118.3	101.7	81.0	94.0	101.6	97.9	97.9	97.0	100.7	100.7						
12	121.6	100.0	86.6	95.8	106.4	93.1	99.1		100.0							

TABLE 7  
INDIVIDUAL FEED AND GROWTH RECORDS OF JERSEY HEIFERS RAISED BY THE MINIMUM-SKIM-MILK METHOD

Herd No.	Total feed consumed					Growth measurements							Digestible nutrients consumed	
						At birth		At 6 months			Height at 6 months	Per cent normal		
	Whole milk	Skim milk	Concen- trates	Alfalfa hay	Body weight	Per cent normal	Body weight	Increase	Per cent normal	Total			Per pound gain in weight	
453	pounds 169.2	pounds 823.6	pounds 473.3	pounds 332.7	pounds 60.0	per cent 109.1	pounds 274.0	pounds 214.0	per cent 105.4	inches 37.2	100.8	pounds 609.2	pounds 2.8	
455	116.1	595.4	235.5	185.0	47.0	85.5	152.0	105.0	58.5	32.4	87.8	335.2	3.2	
456	97.2	748.1	325.1	304.1	57.0	103.6	220.7	163.7	84.9	35.3	95.7	470.9	2.9	
458	136.0	554.3	293.4	238.8	54.0	98.2	221.9	167.9	85.3	35.7	96.7	403.4	2.4	
462	79.7	647.1	292.6	257.3	44.0	80.0	199.4	155.4	76.7	33.1	89.7	411.7	2.6	
464	81.3	785.3	374.8	264.4	53.0	96.4	235.6	182.6	90.6	35.0	94.9	486.4	2.7	
466	97.2	731.9	535.7	135.4	45.0	81.8	253.0	208.0	97.3	35.1	95.1	531.5	2.6	
468	96.6	741.0	472.1	100.2	41.0	74.5	228.0	187.0	87.7	35.5	96.2	469.0	2.5	

this last consisted of 500 pounds of barley and 200 pounds of rice bran. From birth to six months of age, it is extremely important to feed an unlimited quantity of hay and up to 5 pounds of concentrates daily.

*Minimum Whole Milk.*—This method,<sup>(6 7)</sup> while not so satisfactory as those given above, is applicable where skim milk is not available and whole milk is expensive.

The whole-milk method is used during the first 50 days; then the milk is gradually eliminated, and the animals are induced to consume as much as possible of a palatable concentrate mixture and fine leafy alfalfa hay. At 60 days of age the milk may be entirely eliminated. The following mixture may be used :

200 pounds of rolled or ground barley
50 pounds of rolled oats
50 pounds of wheat bran
50 pounds of linseed oil meal
3 pounds of salt
6 pounds of mineral supplement

Although the cost would be increased, the above concentrate mixture would be improved by the addition of 50 pounds of dry skim milk.

No attempt should be made to raise any but the strongest calves by the minimum-whole-milk method.

*Dry Skim Milk and Dry and Semi-solid Butter Milk.*—The increase in the manufacture of dry skim milk has brought this product within price range as a calf food. That it is equal in value to the fresh skim milk has been demonstrated at several experiment stations.<sup>(7)</sup> The dry skim milk is reconstituted by mixing one pound with nine pounds of water.

There are several methods of utilizing dry skim milk in the calf ration. The most common one is that of substituting the reconstituted for fresh skim milk, pound for pound. To prepare the reconstituted skim milk, a little cold water should be added to the necessary quantity of powder and this mixed to a smooth paste. Then sufficient warm water to make up the correct proportion of powder and water should be added, thoroughly mixed, and fed at body temperature, 100° F.

Another method of utilizing dry skim milk<sup>(8)</sup> consists in rearing the calf on reconstituted skim milk to the age of 7 weeks, when the amount of milk should be reduced gradually until, at the end of the eighth week, it may be discontinued. The following concentrate mixture should be available to the calf after 10 days of age: 55 pounds of yellow corn meal, 10 pounds of wheat bran, and 26 pounds of dry skim milk. To this should be added 2 pounds of salt and 1 pound of



steamed bone meal. Mixed hay should be used during the first few weeks, and after the second month, alfalfa or clover hay. The consumption of the concentrate mixture should be increased until the calf is getting from 4 to 6 pounds daily. This amount should be continued until the calf is four months old, when the dry skim milk may be gradually reduced and finally discontinued. The following is recommended to take the place of the concentrate mixture formerly used: 200 pounds of cracked corn, 100 pounds of wheat bran, 100 pounds of ground oats, and 75 pounds of linseed meal. To this should be added 10 pounds of salt.

Dry buttermilk may be used in the same way as dry skim milk,<sup>(9)</sup> but somewhat greater care must be taken in starting the calves on it because of its acidity. Semi-solid buttermilk<sup>(9)</sup> when mixed with three times its weight of warm water may also be used, but it is not so satisfactory as the dry product, because it does not keep so well.

*Milk Substitutes.*—A calf meal or milk substitute is a mixture of such materials as red dog flour, ground corn, linseed oil meal, oat flakes, flaxseed meal, blood meal, and dry skim milk, and is designed to take the place of milk in raising dairy calves.

So far no one has succeeded in finding a complete substitute for milk during the early life of the calf. Best results with so-called milk substitutes are obtained when some milk is fed for the first 30 or 40 days. One of the best home-made calf meals, the Purdue mixture, consists of equal parts by weight of the following: hominy feed, linseed oil meal, red dog flour, and dried blood.

When a commercial calf meal is used, the directions on the bag should be followed explicitly. In the case of the home-made product, one pound of the meal is mixed with 9 pounds of water. An amount of the gruel equivalent to a skim-milk ration should be used. To prepare the gruel, it is best to make a thick, smooth paste of a small amount of cold water and the required amount of meal; to this add sufficient boiling water to make the correct proportion of meal and water. This gruel should be fed at 100° F. The feeding schedule shown in table 8 is recommended by the Missouri Experiment Station.<sup>(10)</sup>

As in the other methods, hay and a concentrate mixture should be available at all times—either that recommended for the calf reared on skim milk, or one consisting of 4 parts of rolled or ground barley, 1 part of wheat bran, and 1 part of linseed meal plus 1 per cent of salt and 2 per cent of a mineral supplement.

The calf receiving a milk substitute does not, as a rule, make such rapid gains as one fed skim milk. For this reason, the feeding of concentrates and hay should be continued to a later age than would otherwise be necessary.

The milk-substitute method will prove successful only where special attention is paid to every detail. The schedule shown in table 8 is merely a guide. Individual animals require special care and attention. Unusually large calves may be given somewhat larger

TABLE 8  
DAILY FEEDING SCHEDULE FOR CALVES ON CALF MEAL

Age	Milk	Gruel	Concentrate	Hay
	<i>pounds</i>	<i>pounds</i>	<i>pounds</i>	
1 to 3 days.....	Leave with mother		0	0
3 to 14 days.....	10	0	0	0
14 to 21 days.....	9	1	0	0
21 to 30 days.....	9	3	Very little	Free access to coarse hay or limited amount of alfalfa
30 days to 6 weeks.....	6	6	Very little	Free access to coarse hay or limited amount of alfalfa
6 weeks to 2 months.....		12	$\frac{1}{2}$	Small amount of alfalfa hay
2 months to 3 months.....		14	1	Free access to alfalfa hay
3 to 4 months.....		14	2	Free access to alfalfa hay
4 to 5 months.....		14	4	Free access to alfalfa hay
5 to 6 months.....			$4\frac{1}{2}$	Free access to alfalfa hay

quantities than those specified. The feeder must be capable of judging the requirements of each individual, particularly whether it is being overfed, a condition even more serious than underfeeding. Gruel feeding may be discontinued at 4 months of age, though somewhat better results will be obtained by continuing it to 5 or 6 months.

#### CARE FROM SIX MONTHS TO ONE YEAR OF AGE

The growth of the dairy heifer from birth to first calving seems to fall naturally into six stages. The two days following birth constitute the first. During the next stage, which extends through the second week, the calf usually gets its start in life on whole milk. In the third or transition period, the change is usually made from whole to skim milk or some milk substitute. The fourth carries the calf to the age of 6 months or past the periods of greatest mortality. A calf normal at birth and given proper care up to this age, presents a relatively simple problem during the fifth period, or from 6 months to one year, demanding only good judgment on the part of the feeder. This is also true of the sixth period which extends from one year to

first calving. In many cases, however, after caring for the young heifers very conscientiously from birth to 6 months, he then erroneously assumes that they are now capable of taking care of themselves, and gives no concentrates during the pasture season and little more than roughage during the winter months. In many sections of California where pasture is available during 9 months of the year, this danger is greater than in colder parts of the country where the heifers are brought up from the pasture in the fall and must be fed concentrates. In the latter case, the animal has an opportunity to store up some reserve for the pasture season.

Many dairymen have the mistaken idea that grass is a perfectly balanced food for young stock. It contains about 80 per cent of water, and the digestive organs of the calf under 10 months of age are incapable of handling sufficient amounts of this food for normal growth. It is therefore necessary to feed a sufficient amount of concentrates to keep the heifer growing rapidly. Heifers that are under weight at 6 months of age should receive somewhat larger quantities. The amount of concentrates to feed at any time can be determined by weighing the heifer and comparing with the norm shown in table 2.

The concentrate mixture may consist of 400 pounds of rolled barley and 100 pounds of wheat bran as a supplement to alfalfa pasture, while for grass pasture the same mixture, with the addition of 50 pounds of linseed-oil meal, should give satisfactory results. Other grains may be substituted if the cost per pound is less than barley.

In those parts of California where the pasture dries up during the latter part of the summer, it is necessary to supply hay as well as concentrates.

During the winter months and when there is no pasture, the heifer under one year of age should receive all it will eat of the best available hay and sufficient concentrates to produce normal growth. When alfalfa hay is available the concentrate mixture recommended above for feeding with alfalfa pasture may be used.

If a non-leguminous hay is used, the protein content of the concentrate mixture must be increased as follows:

100 pounds of rolled or ground barley
100 pounds of wheat bran
100 pounds of linseed oil meal
3 pounds of salt
6 pounds of a mineral supplement

## CARE FROM ONE YEAR OF AGE TO FIRST CALVING

Cost is the principal argument against raising dairy heifers. The period from birth to first calving is unproductive. The advantage of early calving is therefore evident. To sacrifice size of animal for early calving is, however, a serious mistake. The undersized heifer, after freshening for the first time, is limited in her ability to produce milk by the fact that the stimulation to grow is still strong. A cow with a strong stimulation to produce milk cannot consume sufficient food for both maximum milk production and normal growth; as a result, both milk production and growth are impaired. Evidently then, one should consider size as well as age when determining the proper time to breed.

Experiments conducted at the California Station have shown that through liberal feeding of concentrates, the rate of growth can be so accelerated that 15-month-old heifers will be as mature as those 17 months of age that have maintained only normal growth. Seven pure-bred Jersey heifers were raised by the skim-milk method to 6 months of age; they were not turned out to pasture, but received alfalfa hay at will and 5 pounds of concentrates daily to an average of 18 months. When they averaged 14.5 months of age these heifers had reached the normal weight for 17 months. The average growth compared to the normal is shown in figure 5

The Missouri Experiment Station<sup>(7)</sup> has also shown that the use of alfalfa alone for growing heifers will not produce normal growth, and that an animal receiving a liberal concentrate ration is as mature at 24 months of age as one raised on hay alone at 30 months.

Heifers that have had a liberal grain ration may be bred 5 or 6 months earlier than those grown on hay alone, or 2 to 3 months earlier than those raised on hay and a limited amount of concentrates.

The all too common practice in California of feeding only rough-age often results in an undersized animal and necessitates delay in breeding. Table 9 shows the proper time to breed in relation to both age and growth.

TABLE 9  
AGE AND WEIGHT SCHEDULE FOR BREEDING DAIRY HEIFERS

Breed	Age to breed <i>months</i>	Normal weight <i>pounds</i>
Holstein.....	19-21	715-774
Ayrshire.....	18-20	604-651
Guernsey.....	17-19	550-598
Jersey.....	16-18	533-572



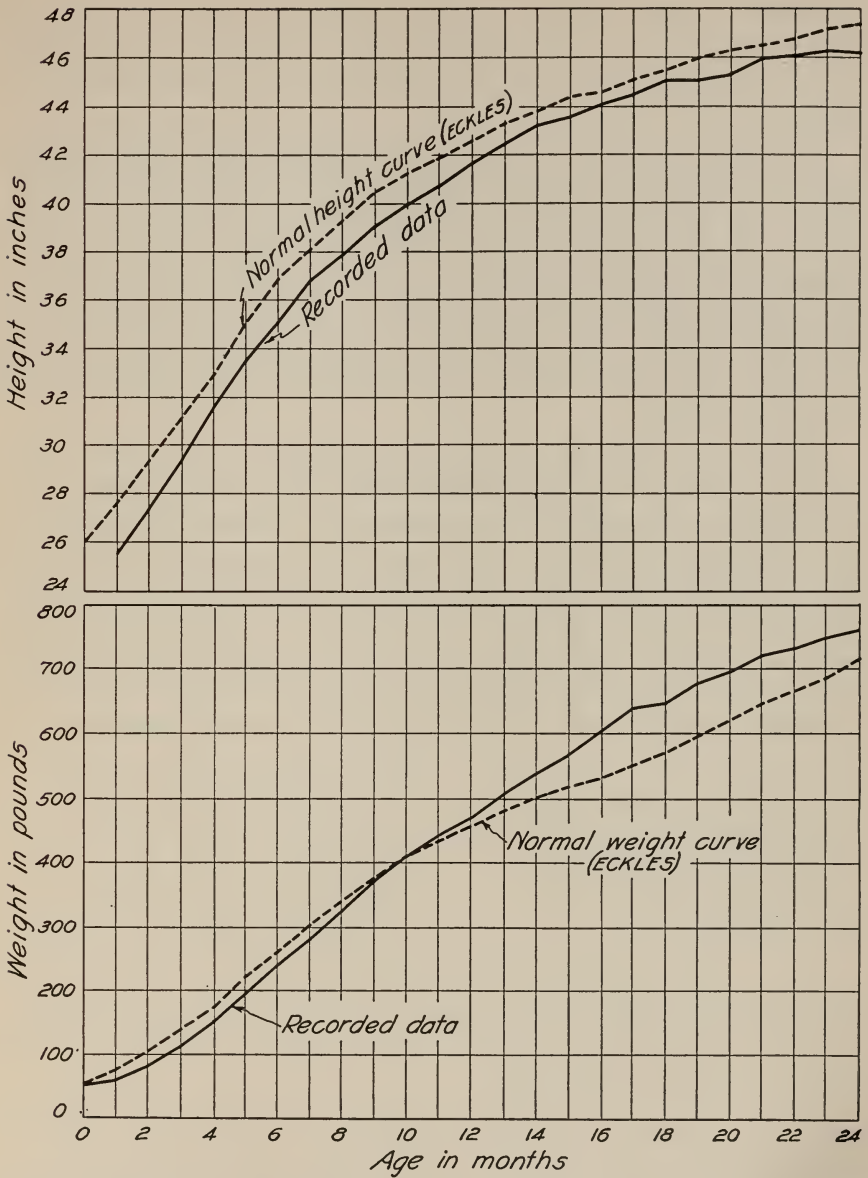


Fig. 5.—Growth of calves which received a liberal-concentrate ration, compared to the normal.

The normally developed heifer at 1 year of age will do very well on pasture alone if this feed is abundant. During the winter months or when pasture is not available, the heifers between 1 year of age and first calving should have free access to the best available hay, and 3 to 5 pounds daily of a concentrate mixture, depending upon their

condition of flesh. Silage is also a very good feed and may be substituted for part of the grain and hay. The feeds recommended for the period from 6 months to 1 year of age may be used during this period.

*Feeding and Management for Parturition.*—The high-producing dairy cow is unable to consume sufficient food to supply the materials needed for milk production during the first part of the lactation period. It is necessary, then, to store in her body during the period preceding parturition a reserve supply of food materials to draw on during this period of heavy production. This is especially true of the first-calf heifer. The stimulation to grow is still strong, and if a sufficient reserve has not been established, both milk production and growth will suffer.

Fitting the heifer for lactation should begin 2 or 3 months before calving. When good pasture is available, no additional roughage need be supplied. The amount of concentrates to feed varies according to the condition of the heifer. As a rule it is well to start with about 2 pounds and increase in ten days to 5 or 8 pounds daily. When no pasture is available, hay must be supplied. In addition silage, root crops, or dried beet pulp, separately or in combination, are desirable. There are a number of concentrate mixtures which may be used during the fitting period. Those listed below should give good results.

<i>To be used with leguminous roughages</i>	<i>To be used with non-leguminous roughages</i>
400 pounds of rolled barley	300 pounds of rolled barley
200 pounds of wheat bran	200 pounds of wheat bran
100 pounds of rolled oats	100 pounds of rolled oats
100 pounds of linseed meal	200 pounds of linseed meal
8 pounds of salt	16 pounds of a mineral supplement
	8 pounds of salt

When other materials of a similar feeding value can be purchased at less cost than those used in the above rations, substitutions should be made. For example, rice bran may be used for wheat bran, and soybean meal for linseed meal.

It is a good plan to fasten the heifers in the stanchions with the milking herd for the feeding of concentrates. The feeder is then in a position to note the condition of the animal and to feed more intelligently. The heifer will also form the habit of coming to the barn at milking time and will soon become accustomed to the surroundings. As a result, she will be more easily handled after freshening.

A week or 10 days before calving, the concentrate mixture should be changed to 2 parts of wheat bran and 1 part of linseed oil meal. It is important at this time to keep the bowels loose. If at any time

there is any tendency toward constipation, a dose of  $\frac{1}{2}$  pound of Epsom salts in a quart of water should be given. At least a week before the calculated date of calving, the heifer should be placed in a clean, well-bedded box stall. A small corral should be furnished where she may exercise alone.

After parturition, the heifer should be protected from cold drafts and should receive very little feed for the first few days. At the end of 24 hours, a warm bran mash with a small amount of hay is usually given as the first food. Warm water should be supplied. Thereafter, the feeder may use the concentrate mixture intended for milk production, starting with one pound a day and gradually increasing this amount to meet the needs of the cow.

### COMMON AILMENTS

*Scours.*—The most common ailment of calves is scours, or extreme looseness of the bowels. In general, there are two classes, known as common scours and infectious scours. So many variations and conditions accompany these that it is not within the scope of this bulletin to deal with the subject in detail. Only general recommendations can be made. In cases where losses persist, information regarding prevention should be obtained by calling a qualified veterinarian to the farm.

Common scours, due to digestive disturbances, may be caused by overfeeding, feeding milk too rich in fat, dirty feeding pails, variation in temperature of milk, or feeding milk alternately sweet and sour. The trouble is more easily prevented than cured. A calf which has received a set-back because of scouring can only with great difficulty be restored to normal growth. In certain cases scouring among calves has been prevented by pasteurizing the milk.

One of the most successful procedures in immediately checking certain outbreaks of scouring in calves under six weeks of age, consists in substituting warm barley water for milk for two days. On the third day equal parts of barley water and milk are fed, and the animal is gradually brought back to milk by the fifth to eighth day. The barley water is prepared by boiling rolled barley in the proportion of one part of the grain to five parts of water. The grain is then strained out through cheese cloth, and the liquid fed at a temperature of about 100° F. The calves when hungry drink it as readily as milk.

Infectious or white scours is a bacterial disease attacking calves at birth or shortly thereafter. The symptoms are dullness, sunken eyes, and profuse discharge of dirty or yellowish white feces of a pasty consistency and an extremely offensive odor. The disease is usually

fatal, for at the present time there are no specific cures. Dead calves should be immediately removed and burned or buried. The bedding should be similarly disposed of, and the stall occupied by the calf and dam, as well as all adjacent stalls, should be thoroughly disinfected. On farms where this disease has recently existed, the maternity stalls should be thoroughly cleaned and disinfected before a cow is allowed to enter. After calving, the udder and teats of the cow should be cleansed and disinfected before the calf is permitted to suck. Immediately after calving, all bedding should be removed and the stalls thoroughly cleansed and disinfected.

At the first signs of white scours, or if this disease is even suspected, a competent veterinarian should be consulted.

*Calf Pneumonia.*—This disease, difficult of treatment and often fatal, is characterized by a profuse discharge from the nose and heavy breathing; it may follow an attack of scouring.

*Lice.*—As a rule, dairy calves are not affected with lice during the summer and fall. In the winter and early spring, however, lice are often present, being most commonly found around the muzzle, eyes, withers, and spinal column. There are many treatments that may be used. Raw linseed oil, rubbed sparingly into the hair, is very effective but will blister the skin unless precautions are taken to keep the animal out of the direct sunlight for several days. A 3-per-cent solution of a coal-tar disinfectant, liberally applied, will control the lice without the danger of blistering. Any treatment for the eradication of lice should be repeated three or four times at weekly intervals. Sodium-fluoride powder mixed with an equal amount of flour or talc may also be dusted into the hair and will be found to give very satisfactory results in combating the biting (non-blood sucking) louse.<sup>3</sup>

*Ring Worm.*—This infection of the skin is made evident by round spots of rough skin devoid of hair, commonly located around the head, and occasionally on other parts of the body also. Unless treatment is administered, the disease tends to spread. The spots should be washed with soap and water, scraped to remove all scaly material, and treated with tincture of iodine.

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<sup>3</sup> Further information on this subject as well as on other parasites may be obtained by writing for Circular 265, Office of Publications, University of California, Berkeley, California.





Fig. 6.—Stalls and pens. The calf barn should be equipped with individual box stalls and community pens.



Fig. 7.—Calf corrals. Exercise is an important consideration.

### CALF QUARTERS

The calf barn should be light, well ventilated, and free from drafts. Individual box stalls should be provided for calves under one month of age, and community pens, equipped with stanchions, for the older animals (figure 6). If possible, the individual box stalls should have tight walls to aid in preventing the spread of unsuspected infectious diseases.

The barn fittings, if of wood, should be removable to allow for thorough disinfection at frequent intervals. If the calves are at any time exposed to infectious diseases, such an arrangement will be very valuable when the premises are being cleaned.

Provisions should be made for the calves to exercise daily. Corrals similar to those shown in figure 7 are very satisfactory.

### RAISING THE HERD SIRE

In most respects, feeding and care are identical for the future herd sire and the heifers. During the growing period, however, it is well to feed the former liberally in order to induce maximum growth; otherwise, it is impossible to judge the inherited size of the animal. Between 4 and 5 months of age the bull calf should be separated from the heifers. Milk feeding should continue to 5 or 6 months of age, and even 2 or 3 months longer for best results. Concentrates and roughage recommended for heifers should be fed liberally.

### CALCULATING THE COST OF RAISING DAIRY HEIFERS

Many requests have been made for information concerning the cost of raising dairy heifers. No definite information can be given for the prices of feeds and other conditions vary considerably throughout the state. The individual dairyman may, however, arrive at a close estimate of the cost by applying local prices to the feeding recommendations that have been made in previous paragraphs.

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